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CLAIMS

1. A magnetoresistive device, comprising:

a synthetic antiferromagnetic (AFM) layer including a first ferromagnetic (FM) layer including iron (Fe), a second FM layer including Fe, said first FM layer and said second FM layer being separated by an intermediate layer including Fe and silicon (Si), wherein said first FM layer has a magnetization that is pinned in a first direction, and said second FM layer has a magnetization that is pinned in a second direction that is substantially antiparallel to said first direction;

a spacer layer overlying said synthetic AFM layer, said first FM layer being proximate said spacer layer and said second FM layer being distal said spacer layer; and

a free layer overlying said spacer layer and formed of a ferromagnetic material.

2. The magnetoresistive device as recited in claim 1, wherein said intermediate layer includes iron-silicide (FeSi).

3. The magnetoresistive device as recited in claim 1, wherein said first FM layer consists essentially of Fe, said second FM layer consists essentially of Fe, and said intermediate layer consists essentially of Fe and Si.

4. The magnetoresistive device as recited in claim 3, wherein said intermediate layer consists essentially of iron-silicide (FeSi).

5. The magnetoresistive device as recited in claim 1, further comprising:

a pinning layer including an antiferromagnetic material, underlying said synthetic AFM layer.

6. The magnetoresistive device as recited in claim 1, further comprising:

pinning means for pinning said magnetization of said second FM layer in said second direction.

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7. The magnetoresistive device as recited in claim 5, further comprising:

a first shield underlying said pinning layer;

a separation layer overlying said free layer; and

a second shield overlying said separation layer.

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8. The magnetoresistive device as recited in claim 7, wherein said separation layer includes:

a metal spacer layer that is non-magnetic and adjacent said free layer; and

a gap fill layer that is separated from said free layer by said metal spacer layer.

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9. The magnetoresistive device as recited in claim 1, wherein said free layer consists essentially of a conductive ferromagnetic material and said metal spacer layer consists essentially of tantalum (Ta).

20 10. The magnetoresistive device as recited in claim 9, wherein said conductive ferromagnetic material is CoFe.

11. The magnetoresistive device as recited in claim 8, wherein said pinning layer is formed of an oxide having antiferromagnetic properties.

12. The magnetoresistive device as recited in claim 8, wherein said pinning layer includes one of NiO, NiCoO, NiFeO, and Fe₂O₃.

13. The magnetoresistive device as recited in claim 8, wherein said pinning layer consists essentially of one of NiO, NiCoO, NiFeO, and Fe₂O₃.

14. The magnetoresistive device as recited in claim 1, wherein between about 25% to about 75% of said intermediate layer is Fe and up to the remaining amount is Si.

15. The magnetoresistive device as recited in claim 14, wherein said intermediate layer includes about 50% Fe and about 50% Si.

16. The magnetoresistive device as recited in claim 14, wherein said intermediate layer has a thickness in the range of about 5 angstroms to about 25 angstroms.

17. The magnetoresistive device as recited in claim 16, wherein said intermediate layer has a thickness in the range of about 10 angstroms to about 20 angstroms.

18. A system for reading from and writing to a magnetic medium, comprising:

a write element;

a read element including a spin valve magnetoresistive device having a synthetic antiferromagnetic (AFM) layer including a first FM layer, consisting essentially of iron (Fe), separated from a second FM layer, consisting essentially of iron (Fe), by a first spacer layer that consists essentially of iron (Fe) and silicon (Si).

19. The system as recited in claim 18, wherein said first spacer layer consists essentially of iron-silicide (FeSi).

5 20. The system as recited in claim 18, further comprising:

a medium support that is capable of supporting a magnetic medium and moving said medium in relation to a read/write head that includes said write element and said read element;

10 a read/write head support system for suspending said read/write head above said medium.

21. The system as recited in claim 20, wherein said read/write head support system includes means for moving said read/write head relative to said medium.

15 22. The system as recited in claim 20, wherein said medium support includes:

a spindle on which said medium can be supported, having an axis about which said medium can rotate; and

a medium motor connected to said spindle and capable of facilitating said moving of said medium relative to said read/write head.

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23. A method of forming a magnetoresistive device, comprising:

providing a substrate; and

forming a synthetic AFM layer having a first iron (Fe) layer and a second iron (Fe) layer separated by an iron-silicide (FeSi) layer.

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24. The method as recited in claim 23, wherein forming said synthetic AFM layer includes the use of molecule beam epitaxy (MBE) techniques.

5 25. The method as recited in claim 23, wherein forming said synthetic AFM layer includes:

depositing a first iron (Fe) initial layer over said substrate;

depositing a silicon (Si) layer over said first Fe layer;

depositing a second Fe initial layer over said Si; and

10 heating said first Fe initial layer, said Si layer, and said second Fe initial layer until material from at least one of said first Fe initial layer and said second Fe initial layer propagates into said Si layer to transform said Si layer into said FeSi layer.

26. The method as recited in claim 23, wherein during said heating, material from the other of said first Fe layer and said second Fe layer also propagates into said Si layer.

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27. The method as recited in claim 25, wherein said heating is conducted to heat said first Fe layer, said Si layer, and said second Fe layer to a temperature in the range of about 150 degrees C to about 250 degrees C.

20 28. The method as recited in claim 27, wherein said heating is conducted to heat said first Fe layer, said Si layer, and said second Fe layer to a temperature of about 200 degrees C.

25 29. The method as recited in claim 23, wherein forming said synthetic AFM layer includes:

forming said first Fe layer above said substrate;

forming said FeSi layer by sputtering Si and Fe substantially simultaneously over said first Fe layer and heating said Fe and said Si to form iron-silicide; and

forming said second Fe layer above said FeSi layer.

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30. The method as recited in claim 29, wherein said heating heats said Fe and said Si to a temperature of about 200 degrees C.

31. The method as recited in claim 23, further comprising:

10 setting a magnetization of said first Fe layer in a first direction; and

setting a magnetization of said second Fe layer in a second direction that is substantially antiparallel to said first direction.

15 32. The method as recited in claim 23, wherein said FeSi layer includes between about 25% to about 75% Fe and Si forms up to the remainder of the FeSi layer.

33. The method as recited in claim 32, wherein said layer including Fe and Si includes about 50% Fe and about 50% Si.

20 34. The method as recited in claim 23, further comprising:

forming a spacer layer over said synthetic AFM layer;

forming a free layer over said spacer layer; and

forming a pinning layer between said pinned layer and said substrate.

35. The method as recited in claim 34, wherein said spacer layer is formed of a non-magnetic metal, said free layer is formed of a ferromagnetic material, and said pinning layer is formed of an antiferromagnetic (AFM) material.

5 36. The method as recited in claim 35, wherein said spacer layer is formed of copper (Cu), said free layer is formed of one of CoFe and NiFe, and said AFM layer is formed of one of NiO, NiCoO, NiFeO, and Fe₂O₃.

37. The method as recited in claim 34, further comprising:

10 forming a first shield between said substrate and said AFM layer; and
forming a second shield over said free layer.

38. The method as recited in claim 37, further comprising:

15 forming a metal spacer layer between said second shield and said free layer, including
a non-magnetic metal material.